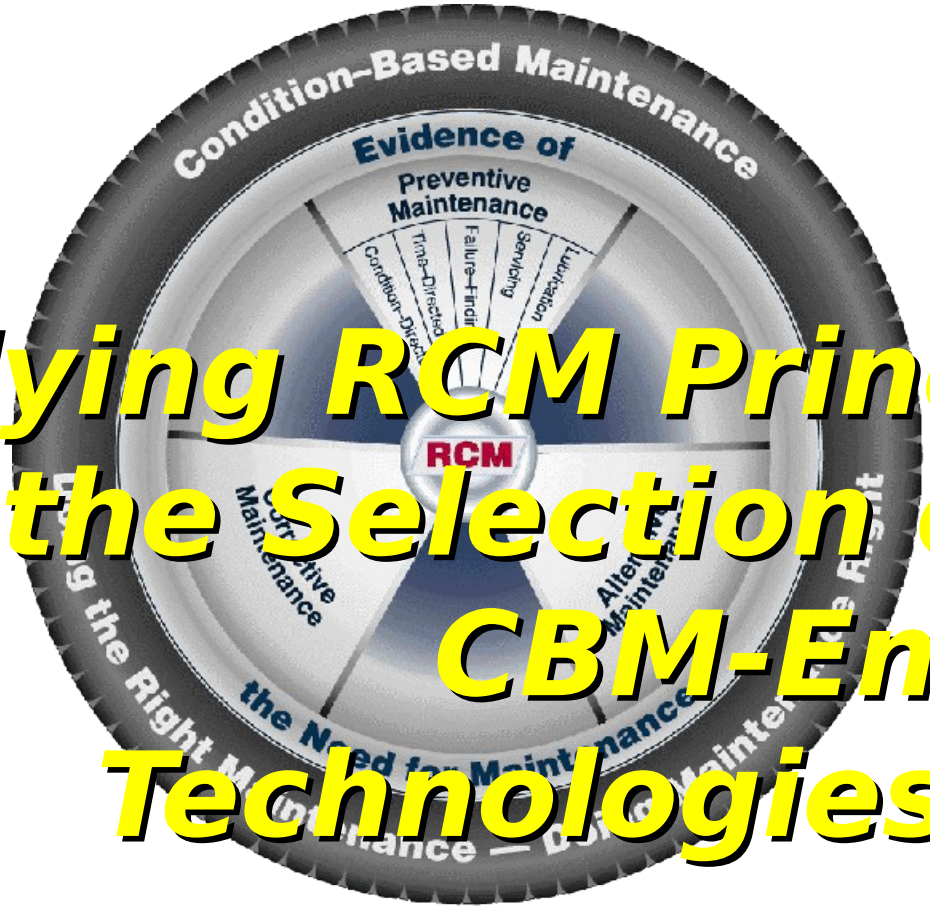
2000 DoD Maintenance Symposium and Exhibition



Applying RCM Principles in the Selection of CBM-Enabling Technologies

SEA 04M1

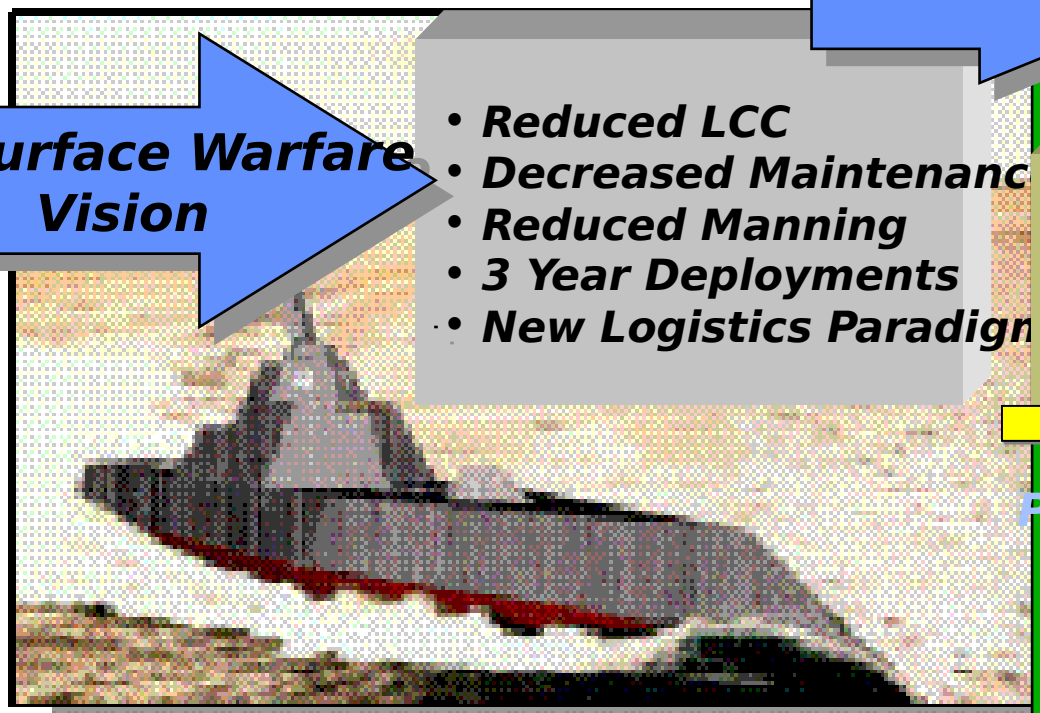
31 October 2000
Charleston, SC

Kenneth S. Jacobs (SEA 04M1)
Director, Maintenance Engineering
Naval Sea Systems Command

CBM Transition

Surface Warfare Vision

- Reduced LCC
- Decreased Maintenanc
- Reduced Manning
- 3 Year Deployments
- New Logistics Paradigm



ACHIEVED WITH BALANCED APPROACH

- CNO maintenance polic
- SURFMER
- AEC
- MRS
- Maintenance Educatio

- Wireless, distributed Networks
- "Smart", self-power Sensors
- Materials / Coatings
- Embedded Training

Policy, Processes & Procedure

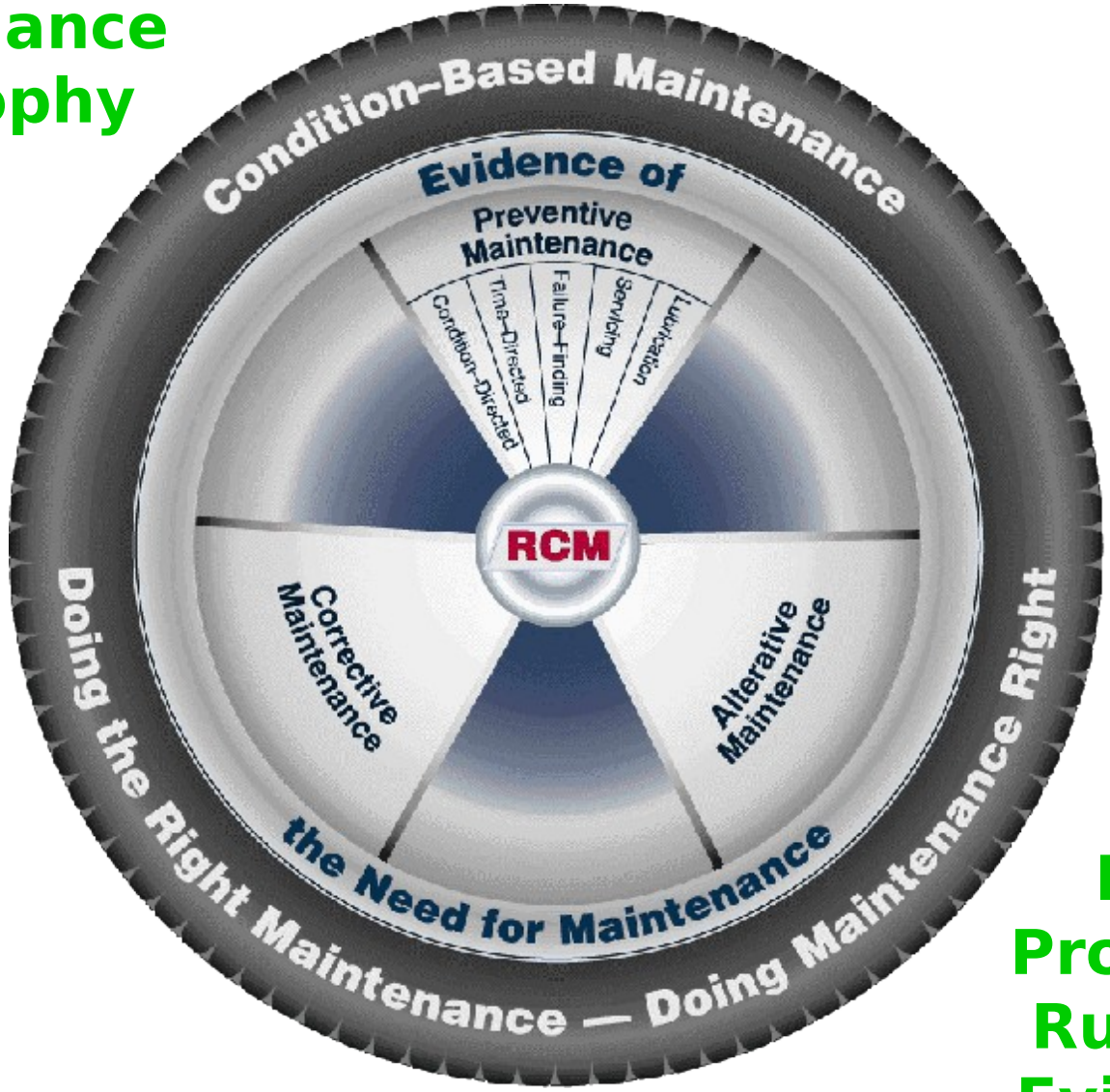
CBM

Enabling Technologies

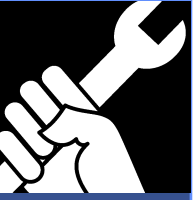
CBM – Enabler and Risk Reducer

RCM Is the Hub of CBM

CBM is a Maintenance Philosophy



RCM Provides Rules of Evidence



Proof of RCM Success: SURFMER

- **The process**
  - Uses a review based on RCM principles
  - Examines planned, preventive maintenance (PMS)
  - Performed by In-Service Engineers (ISEs)
    - SEA 04M1 provides training and post-training support
- **Progress to date**
  - SURFMERs 0 - 31 complete
  - Four-year effort coast-to-coast, starting with Smart Ship
- **Documented SURFMER savings**
  - Exceeded CNO goal of 30% reduction of maintenance manhours

Achieved 40% reduction by Oct 2000

Road Map for applying CBM to Maint[illegible]e Tasks

AGE DEGRADATION *(First Filter)* Verify Requirement Exists

APPLICABILITY *(Second Filter)* Restores or Maintains Original Reliability

EFFECTIVENESS *(Third Filter)* Task Is Worth Doing

Step 1: Identify Failure Mode (E.g., seized bearings)

Step 2: Does a Significant Rate of Age Degradation Exist?

- No → No or Acceptably Slow Rate of Degradation
  - •No task
- Yes → Significant Rate of Degradation

Step 3: Determine/Classify Type Task

TIME-DIR. (TD)	CONDITION-LUBE DIR. (CD)	FAILURE-FINDING (L) (FF)	SERVICING (S)

Step 4: Is the Existing Maintenance Task *Applicable*?

Apply Rules for Applicability

TD: Life Renewal Replace/Restore)

CD: Health Monitoring

FF: Hidden Failure (Find/Repair)

S/L: Servicing and Lubrication

- No → Task Does Not Satisfy Applicability Rules
  - •Redesign
  - •Improve task
  - •"Fix when failed"
- Yes → Task Does Satisfy Applicability Rules

Step 5: Is the Maintenance Task *Effective*?

Apply Rules for Effectiveness

Safety or the Environment (Law)

Operational performance (Mission)

All other failures

- No → Task Does Not Satisfy Effectiveness Rules
  - •Sample Vs 100% inspe[illegible]
  - •Make situational
  - •Redesign task
  - •See other options
- Yes → Task Does Satisfy Effectiveness Rules
  - Schedule Task

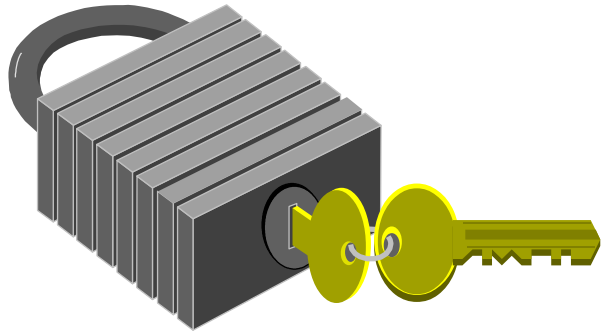
Step 6: Improvement Option Goals

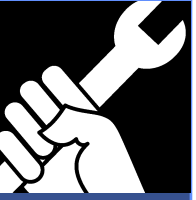
• Develop Recommendations for Ch[illegible]

Continuous Improvement: periodi[illegible] re-evaluation and adjustment of t[illegible]

Choosing CBM Technology

- Can’t afford it all
- Wouldn’t all be worthwhile, anyway
- How to choose?
- RCM is the key





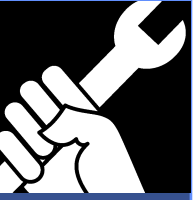
RCM Criteria for CBM-Enabling Technology

- **Failures Happen: Dominant Failure Modes**
  - Failure mode is reasonably likely to occur
- **Applicability**
  - Monitored parameter really correlates to the failure mode; **and**
  - Measures the parameter consistently and accurately; **and**
  - Measurements serve as an accurate indicator of required repair action; **and**
  - There is adequate time for corrective action before functional failure.

RCM Criteria for CBM-Enabling Technology (cont.)

Effectiveness

- ***Safety:*** Identifies repair threshold in time to reduce probability of failure to acceptable level; **or**
- ***Mission:*** Identifies repair threshold in time to reduce risk of failure (probability times severity) to acceptable level; **or**
- ***Economics:*** Identifies repair threshold in time to reduce cost to identify and prevent failure at less cost than repairing after run to failure.

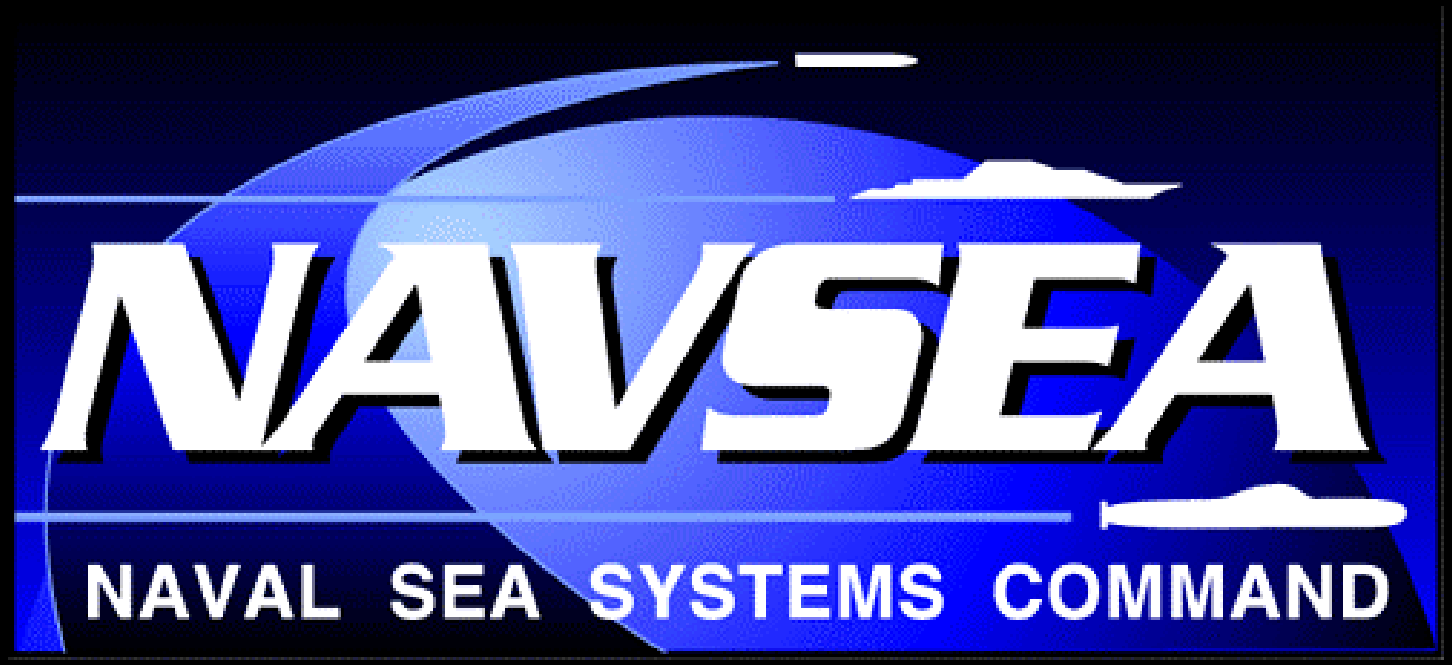


Other Considerations

- **CBM does not eliminate the need for maintenance**
  - Deterioration may occur no matter what the maintenance approach
  - Goal is to maintain or restore reliability at least cost
  - May allow operator to secure an equipment before occurrence of disruptive and more costly failure
- **Costs considered in determination of effectiveness**
  - Hardware and software acquisition
  - Development of operating procedures and parametric values vs. deterioration for monitored equipment
  - ILS costs, including training

Conclusions

- **Application of CBM technology c**
  crucial to a successful CBM trans
- **But only *worthwhile* technology should be applied**
- **A CBM-enabling technology may be worthwhile only if:**
  - There is a specific failure mode that is reasonably likely to occur
  - The technology produces applicable results related to that failure mode
  - The technology allows operators and maintainers to take appropriate action that reduces probability of failure (safety), risk of failure (mission), or cost of prevention to acceptable levels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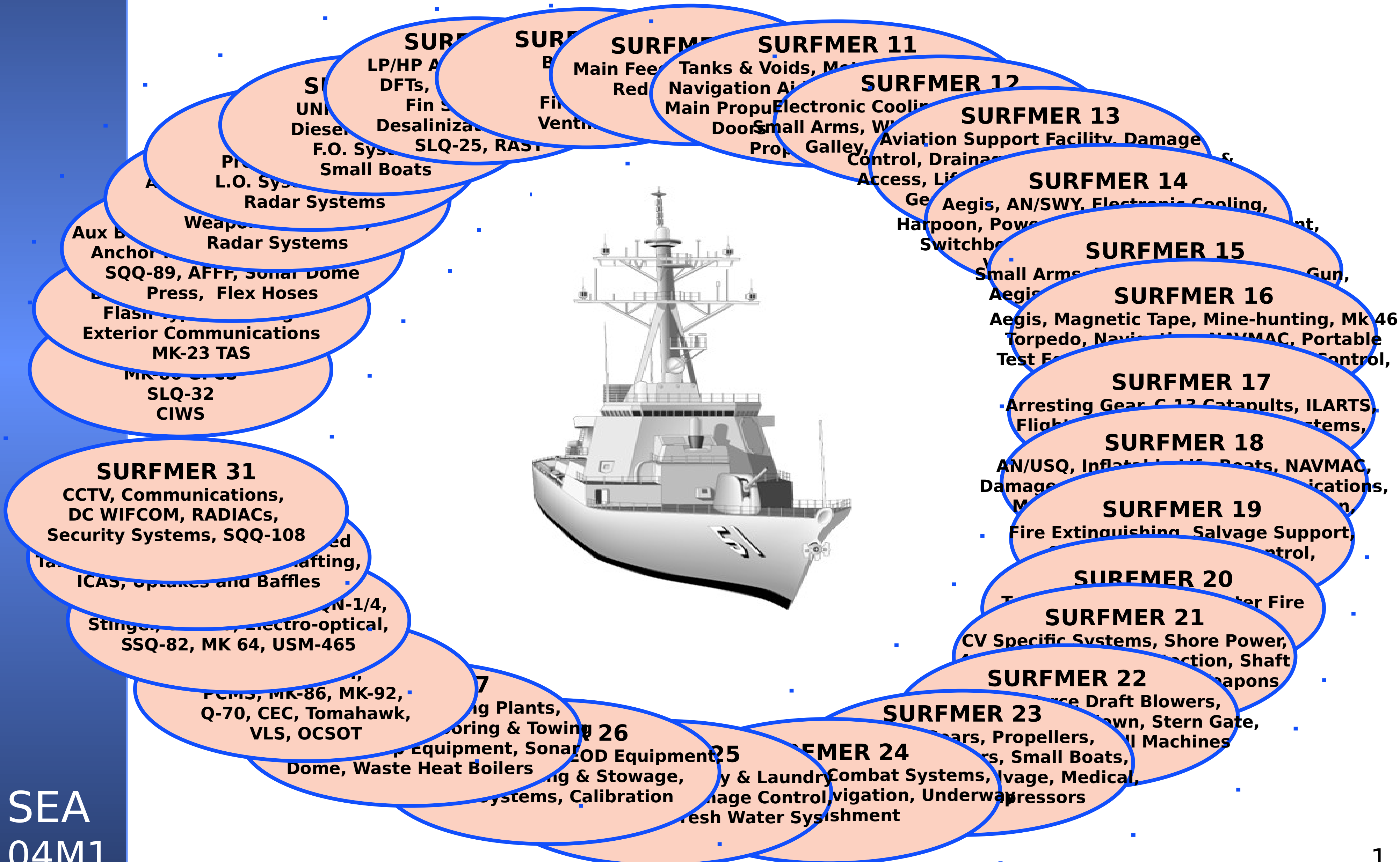
NAVAL SEA SYSTEMS COMMAND

SURFMER Systems to Date



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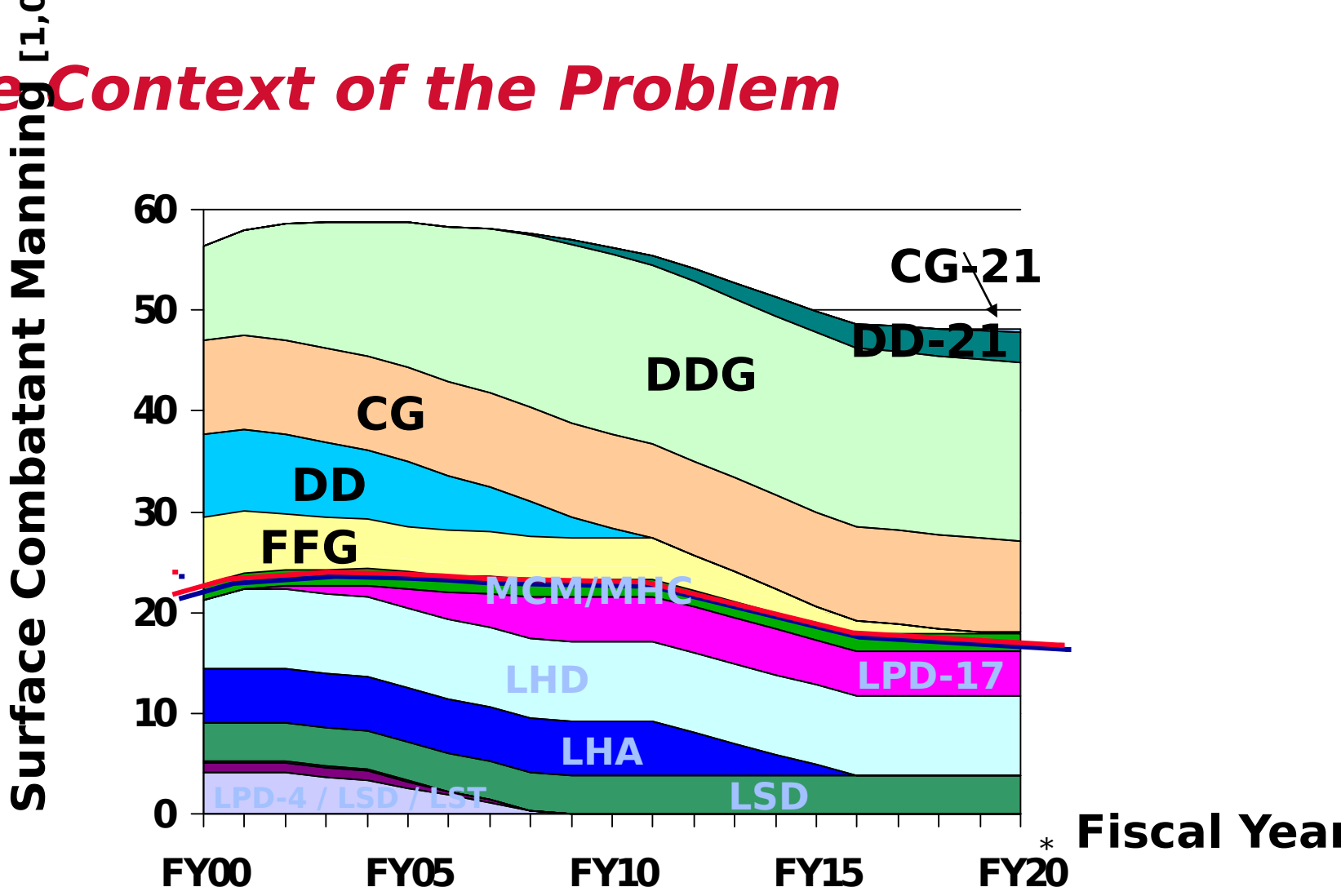
The Context of the Problem



- Legacy fleet:
  - Is sizable
  - Will be with us for some time
  - Must be supported

- New ships & legacy fleet must be totally:
  - Interoperable
  - Compatible
  - Supportable

* *OPNAV N86*

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